MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2015/2016

EME1026 – FLUID MECHANICS

(ME)

16 OCTOBER 2015
9.00 a.m - 11.00 a.m
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question Paper consists of seven pages including the cover page and Appendices.

2. Answer ALL questions. Each question carries 25 Marks and the distribution of the Marks for each question is given in brackets [ ].

3. Write all your answers in the Answer Booklet provided.

Question 1

A 1.2 m x 1.2 m square gate located in the vertical side of an open tank is pivoted about the frictionless hinge as shown in Figure Q1 where h is depth in meter. A horizontal force P, is required to keep the gate from rotating.

(a) Determine the magnitude of the hydrostatic force acting on the square gate in terms of h.

[7 marks]

(b) Determine the location of the hydrostatic force acting on the square gate in terms of h.

[7 marks]

(c) Determine the moment of the hydrostatic force acting on the square gate in terms of h with respect to an axis which coincides with the hinge.

[4 marks]

(d) Determine the depth h for the situation when P= 0.

[3 marks]

(e) If the water in the open tank is replaced by oil, would the depth h increase, decrease or remain unchanged for the situation when P =0 ? State the reason. Given that the specific weight of oil is 8.95 kN/m^3.

[4 marks]

Note: Force P is not needed to solved part (a) ,(b) and (c).

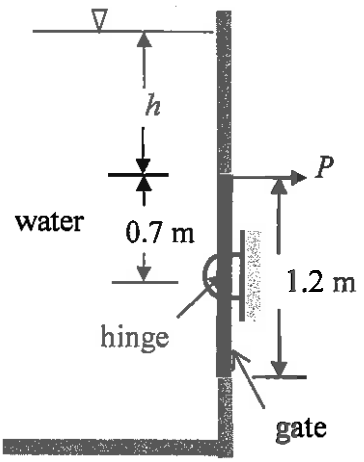

Figure Q1

Continued...

Question 2

(a) A fire hose nozzle having a 3-cm diameter at the exit delivers 0.01 m^3/s of water. If the nozzle is attached to a 7.5-cm diameter hose as shown in Figure Q2a, find the pressure just upstream the nozzle at point (1) to deliver this flowrate.

[8 marks]

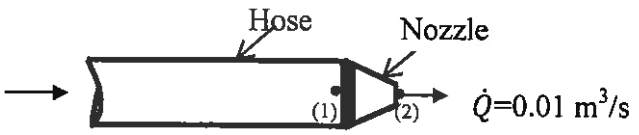

Figure Q2a

Note: The pressure at the nozzle exit is atmospheric pressure. You may apply Bernoulli's Equation between the upstream of nozzle, (1) and nozzle exit (2).

(b) A steady water jet with a mass flow rate of 200 kg/s strikes an angled barrier as shown in Figure Q2b. Twenty percent of the jet passes through the slot. The rest splits symmetrically along the barrier. Assume pressure and velocity are constant everywhere.

(i) Find the velocity, V of the water jet.

[3 marks]

(ii) Calculate the horizontal force, F needed to hold the barrier.

[14 marks]

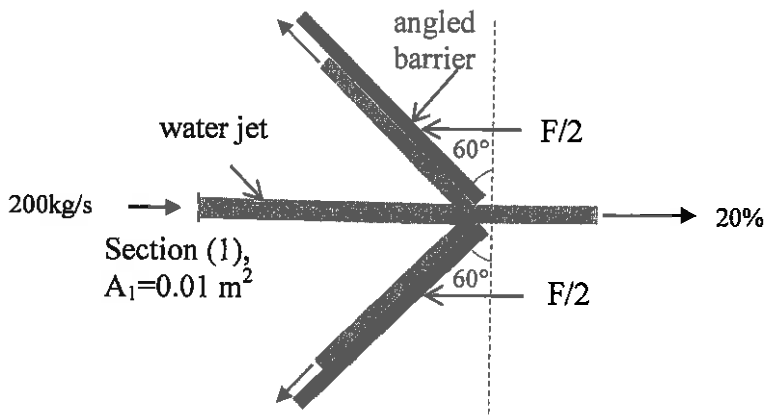

Figure Q2b

Question 3

Water flows through a 5 cm diameter pipe with a velocity of 4.5 m/s as shown in Figure Q3. The relative roughness of the pipe is 0.004 and the loss coefficient for the exit is 1.0. The dynamics viscosity of water is 1.12×10^{-3} N.s/m^2.

(a) Write a balanced energy equation.

[11 marks]

(b) Calculate the Reynold number in the water pipe,

[5 marks]

(c) Determine the friction factor, and

[4 marks]

(d) Determine the height, h, to which the water rises in the piezometer tube, in m.

[5 marks]

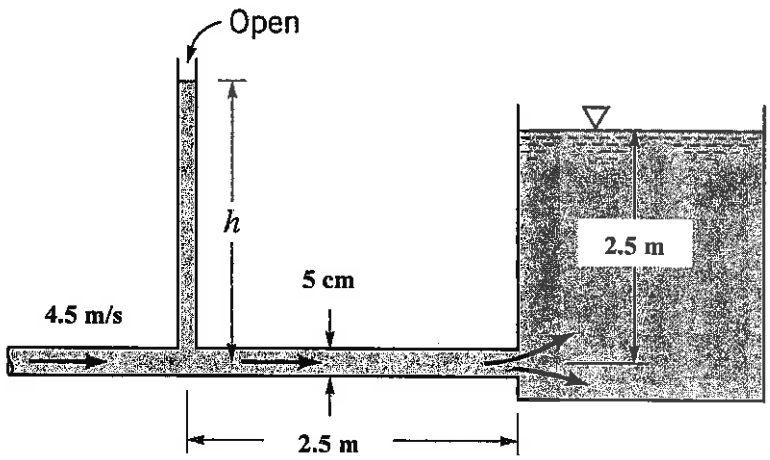

Figure Q3

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Question 4

A cylinder with a diameter D, floats upright in a liquid as shown in Figure Q4. When the cylinder is displaced slightly along its vertical axis, it will oscillate about its equilibrium position with a frequency, ω. Assume that this frequency is a function of the diameter, D, the mass of the cylinder, m, and the specific weight, γ, of the liquid. With the aid of dimensional analysis, answer the following questions in sequence.

(a) List all the variables that are involved in the problem. [3 marks]

(b) Express each of the variables in term of basic dimensions using the FLT system. [4 marks]

(c) Determine the required number of pi terms. [3 marks]

(d) Form the pi term(s) by inspection using the FLT system. [3 marks]

(e) Check the resulting pi term(s) using the MLT system. [3 marks]

(f) How is the frequency related to these variables? [6 marks]

(g) If the mass of the cylinder is increased, would the frequency increase or decrease? [3 marks]

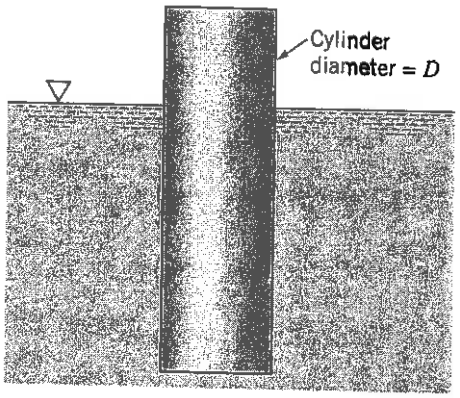

Figure Q4

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APPENDIX 1: Friction factor for fully developed flow in circular pipes

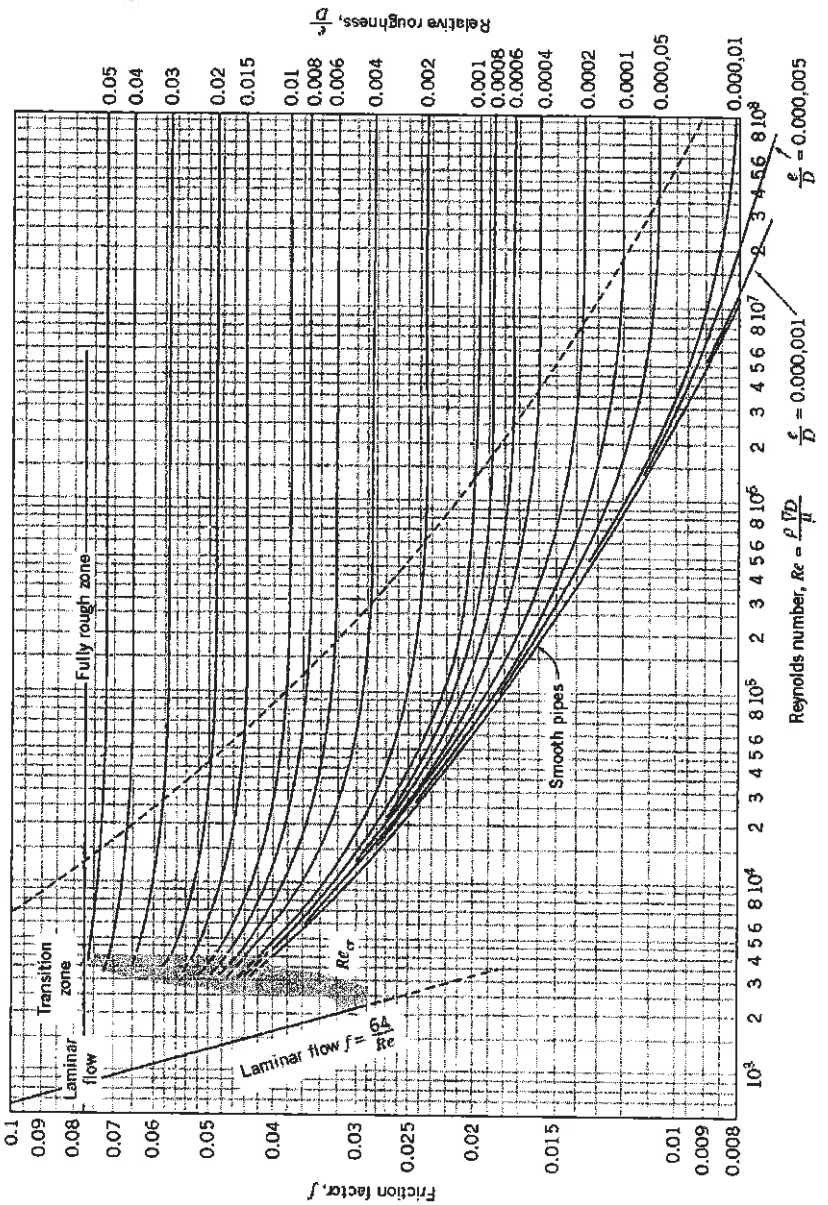

Fig. 8.13 Friction factor for fully developed flow in circular pipes. (Data from [8], used by permission.)

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APPENDIX 2: Equivalent roughness in circular pipe

	Equivalent Roughness, ε	
Pipe	**Feet**	**Millimeters**
Riveted steel	0.003–0.03	0.9–9.0
Concrete	0.001–0.01	0.3–3.0
Wood stave	0.0006–0.003	0.18–0.9
Cast iron	0.00085	0.26
Galvanized iron	0.0005	0.15
Commercial steel or wrought iron	0.00015	0.045
Drawn tubing	0.000005	0.0015
Plastic, glass	0.0 (smooth)	0.0 (smooth)

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